What is Claimed is:

1. A shape memory polymer comprising chemically cross-linked polycyclooctene synthesized from cis-cyclooctene having a high trans double bond content.

2. A shape memory polymer according to claim 1 which has been cured by adding dicumyl peroxide to the polycyclooctene.

3. A shape memory polymer according to claim 2 further cured through chemical crosslinking upon heating.

4. A shape memory polymer according to claim 3 which after curing is cooled to room temperature.

5. A shape memory polymer according to claim 1 having a molecular weight ranging (kg/mol) of about 120 to about 325.

6. A shape memory polymer according to claim 2 having a tunable transition temperature (T_m of PCO) of about 19 to about 61 °C.

7. A shape memory polymer according to claim 2 having a melting point T_m of about 16 to about 61 °C.

8. A shape memory polymer according to claim 2 having a crystallization point T_c of about 16 to about 39 °C.

9. A shape memory polymer according to claim 2 having a melting enthalpy $\Delta H/J_g^{-1}$ of about 22 to about 63.

10. A shape memory polymer according to claim 2 having a melting point T_m of about 16 to about 61 °C, a crystallization point T_c of about 16 to about 39 °C and a melting enthalpy $\Delta H/J_g$ of about 22 to about 63.

11. A shape memory polymer according to claim 2 having a degree of crystallinity at room temperature of from about 2.6% to about 25.5%.

12. A shape memory polymer according to claim 2 evidencing rapid shape memory behavior.

13. A shape memory polymer according to claim 12 wherein the primary stress-free shape of the polymer is recovered within about 1 second on exposure to temperatures above the melting point of the crystalline polymer phase.

14. A shape memory polymer comprising a blend of a polymer according to claim 1 with a member selected from the group consisting styrene butadiene, EVA and polyurethane.

15. A shape memory polymer molded article formed from a chemically crosslinked polycyclooctene according to claim 1.

16. A shape memory polymer molded article formed from the blend according to claim 14.

17. Method of forming a shape memory polymer comprising conducting a ring opening metathesis polymerization of cis-cyclooctene in the presence of a Grubbs catalyst and reacting the polycyclooctene formed with dicumyl peroxide at an elevated temperature to cure the polycyclooctene.

18. Method according to claim 17 wherein said catalyst is $RuCl_2(=CHPh)(PCy_3)_2$.

19. Method according to claim 17 wherein said catalyst is a dihydroimidazolyidene-modified Grubbs catalyst.

20. Method according to claim 17 wherein said curing is carried out in a mold.

21. A shape memory polymer produced by the process of claim 17.

22. An impression material for molding, duplication, rapid prototyping, and embossing comprising a shape memory polymer according to claim 2.

23. A temperature sensor comprising a shape memory polymer according to claim 2.

24. A medical impression material for dentistry, orthopedics and podiatry comprising a shape memory polymer according to claim 2.

25. A shape memory polymer according to claim 1 containing a member selected from the group consisting of finely divided organic and inorganic fillers.

26. A shape memory polymer according to claim 25 wherein said filler is a member selected from the group consisting of born nitride, silica, titanium dioxide, montmullinite, clay, Kevlar, staple, aluminum nitride, barium and bismuth subcarbonate.

27. A shape memory polymer according to claim 26 wherein said filler is boron nitride.

28. A shape memory polymer according to claim 27 wherein said filler is titanium dioxide.

29. Method for increasing the shape recovery rate of a shape memory polymer according to claim 1 which comprises incorporating therein boron nitride as a filler.

30. Method for decreasing the temperature for shape recovery of a shape memory polymer according to claim 1 which comprises incorporating therein boron nitride as a filler.

31. Method for simultaneously increasing the body-temperature modulus and the UV absorption of a shape memory polymer according to claim 1 which comprises incorporating therein titanium dioxide as a filler.